

2013 UDOT RESEARCH PROBLEM STATEMENT

*** Problem statement deadline is March 25, 2013. Submit statements to Steve Bagley at sbagley@utah.gov ***

Problem Title: Evaluating the Feasibility of Creating Virtual Driving Scenarios Using LiDAR Data for Driving Simulators

No. : UT-13.03.20

Submitted By: Mitsuru Saito and Richard J. Porter

Organization: BYU and University of Utah

Email: msaito@byu.edu and richard.jon.porter@utah.edu

Phone: 801-422-6326 and 801-585-1290

UDOT Champion (suggested): To be determined by the Traffic Management & Safety Group

Select a Subject Area

☐ Materials/Pavements

☐ Maintenance

☒ Traffic Mgmt/Safety

☐ Geotechnical

☐ Preconstruction

☐ Planning/Asset Mgmt

☐ Transportation Innovation

1. Describe the problem to be addressed.

Crash analyses will locate high-risk safety hot spots. Network-level hot spot analyses typically use traffic data and physical data to identify them. Human factors that might have contributed to the crashes at hot spots are often excluded from such analyses because human factor data are not available in crash reports. If virtual driving scenarios can be created for driving simulators, we will be able to analyze what kind of driver behaviors might have contributed to such crashes. Creating virtual driving scenarios that reflect what's really there in the hot spot segments of highways has been difficult. LiDAR data that UDOT has collected give an opportunity to create such true-to-reality virtual driving scenarios for driving simulators. The Utah Traffic Lab owns a driving simulator and together with the availability of LiDAR data, we have a choice opportunity to explore this possibility of evaluating drivers' responses to physical and traffic stimulus that safety hot spots exert on the drivers that might lead to potential crashes.

2. Describe why this research is important and how it is unique.

Due to the lack of data, human factors are not considered in typical crash hot spot analyses. However, if virtual driving scenarios of safety hot spots are created for driving simulators, they will allow UDOT engineers to analyze human and physical environment interactions that might have contributed to the occurrence of more than usual crashes at such hot spots. Such analyses will help UDOT engineers to evaluate potential causes for crashes or likely chains of events that might have led to crashes and identify appropriate countermeasures.

3. List the research objective(s) to be accomplished:

1. Evaluate the feasibility of using LiDAR data to create virtual driving scenarios for driving simulators
2. Create a prototype scenario for a crash hot spot identified by crash analyses
3. Conduct an exploratory study to incorporate human behaviors in selecting safety countermeasures

4. List the major tasks to accomplish the research objective(s):

1. Literature review on virtual driving scenario production and driver simulator related research (Phase I)
2. Evaluate the data structure of LiDAR data (Phase I)
3. Evaluate the steps needed to transform LiDAR data for creating virtual driving scenarios (Phase I)
4. Study the tasks required to create scenarios for the driving simulator available at the Utah Traffic Lab (Phase I)
5. Create a driving scenario for the driving simulator at the Utah Traffic Lab using a hot spot identified by safety hot spot analyses as an example (Phase I)
6. Write a report summarizing the findings from Tasks 1 through 5 in the first phase (Phase I)
7. Set up an experiment to observe driver behaviors using the virtual driving scenario developed in task 5 (Phase II)
8. Collect driver behavior data and analyze them (Phase II)
9. Summarizing findings from driver observation and recommend for potential countermeasures that reflect the findings from driver observation (Phase II)
10. Recommend directions for including human factor observations process in developing design alternatives to reduce crashes
11. Write a report summarizing the findings from Task 8 through 11 in the second phase (Phase II) and a promotional video that UDOT requires (Phase II)

5. List the deliverable(s) to come to UDOT from this research study:

1. Final report summarizing all the tasks (Phase I)
2. Procedure to create virtual driving scenarios using LiDAR data for the driving simulator at the Utah Traffic Lab and a sample driving scenario (Phase I)
3. Finding from an experimental test and recommendations for full integration of the driving simulator in safety analysis of hot spots (Phase II) and a video presenting the development process, a sample human factor data collection.

6. Describe how the results of this study will be implemented at UDOT.

UDOT can collect data on human factors that might have contributed to crashes that have happened at crash hot spots and the findings from the study of human factors can be used to identify most appropriate and cost effective countermeasures to reduce crash occurrence at the selected crash hot spot.

7. Estimated cost - Total: \$70,000 (Phase I) & \$50,000 (Phase II) **UDOT Share:** \$70,000 (Phase I) & \$50,000 (Phase II)
Other/Matching Funds: \$

8. Outline the proposed schedule for this study, including estimated start date, duration, and major event dates.

It is recommended that this project begin in later summer or early Fall 2013 with the initial tasks of the project scope of work and detailed estimate, followed with the literature review. It is anticipated that the project would take 18 to 24 months, including a 4-month report review period.

